Drive Devices and Method for Driving a Processing Machine

Specification

The invention relates to drive unit arrangements and
methods for driving a processing machine, in particular for
processing webs, in accordance with the preambles of claims
1, 4, 15, or 30, 31, 33, 43 and 45.

A drive unit arrangement is known from DE 37 30 625 A1,
wherein a primary station is assigned to each print unit, or
to the folder of a printing press, which receives operating
set points from a higher-order control device and passes them
on to the secondary stations of the components involved.

DE 42 14 394 C2 discloses a drive unit arrangement for
a printing press without a longitudinal shaft, wherein the
folder is connected in respect to data with the groups of
print locations via a bus. The folder provides its position
reference to the groups of print locations. A drive control,
which is common for the drive units of a single group of
print locations, performs the fine adjustment of these drive
units in respect to each other, as well as in relation to the
folder.

A drive connection is known from EP 1 287 987 A1,
wherein set points for angle positions and for speeds are
generated for the individual drive units and are transmitted
to all drive units at predetermined time intervals via a
network.

A drive control mechanism is known from EP 1 151 865
A2, wherein actual master shaft pulses, as well as phase
corrections, for the individual drive units are transmitted

to the respective drive units via common network. In one embodiment no correction value is transmitted to the drive unit of the folder, since its position is used as a reference.

The object of the invention is based on creating drive unit arrangements and methods for driving a processing machine.

In accordance with the invention, this object is attained by means of the characteristics of claims 1, 4, 15, or 30, 31, 33, 43 and 45.

The advantages which can be gained by means of the invention lie in particular in that by using the position reference of the electronic master shaft it is easier to manipulate errors regarding measuring systems and/or mechanical drive systems occurring in the printing units, as well as the folder. Because of the lack of interaction and the reference to a common master shaft it is possible to set offset values for the drive units of the printing units, as well as for the folder, in respect to the master shaft and, in an advantageous embodiment, to specify them for a defined type of production (web track).

An embodiment is of advantage wherein an offset value in respect to the master shaft can be set, or specified, for each rotatory drive unit of the print units (at least the drive units of the forme cylinders, which are driven independently of other forme cylinders) and the folder. These offset values are set, for example in the respective drive controller of the drive unit, or preferably in a lower-order drive control unit, or are stored there as offset. The specification of a defined offset value can be entered or

changed, for example, at a control console and/or can be
stored there for a defined type of production, and can be
called up there, and thereafter transmitted to the drive
controllers or the lower-order drive control units.

The embodiment is of advantage, wherein the processing
of the control signals for all relevant drive units does not
take place in a higher-order drive control unit, but wherein
only a higher-order master shaft movement is transmitted by
this drive control unit. The specific processing for an
individual drive unit takes place in the drive unit itself,
or in a lower-order control device, on the basis of the
master shaft movement and additional specific information
(for example offset and/or deviation from the angular
position set point). The signal line (network) provided for
the master shaft is not unnecessarily burdened by a large
number of different jobs for each one of the individual drive
units, the repetition frequency for the position information
and/or the dependability can be increased. In one variation,
the generation of the higher-order master shaft movement is
taken over by one of several cross-linked lower-order drive
unit control devices, which can then be considered to be the
higher-order drive control unit (master). In this case, too,
the cross linkage only carries the signals of the higher-
order master shaft movement. A drive unit control device,
which would be provided separately, can be omitted in this
case.

In an advantageous embodiment, networks differing from
each other are provided for conducting the signals from the
rotating electronic master shaft and for transmitting values
which are specific to the drive units such as, for example,

offset values in respect to the master shaft position. This serves the dependability in the transmission and speed in the course of data transmission.

An embodiment is advantageous, wherein a lower-order drive control unit is provided between the drive unit to be controlled and the drive control unit which provides the master shaft position, which picks up the overlapping master shaft position and, derived therefrom, performs the individual control (angular position, angular speed) of the associated drive unit. In case of a printing unit with several printing groups, or of a printing tower, several drive units are advantageously assigned to this lower-order drive control unit.

Exemplary embodiments of the invention are represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a first exemplary embodiment of the drive unit,

Fig. 2, a second exemplary embodiment of the drive unit,

Fig. 3, a third exemplary embodiment of the drive unit,

Fig. 4, a schematic representation of a drive units,

Fig. 5, a schematic representation of the relative positions during operation.

A processing machine for web-shaped materials, for example a printing press, in particular a web-fed rotary printing press, has several units, which are mechanically independent of each other, and each is driven by a drive motor M. These units, which are driven independently of each other can work together, for example directly or indirectly,

with a web, for example a web of material to be imprinted,
passing through the printing press, and therefore must be
aligned in respect to their relative position to the web, or
to each other. Such units can be printing towers 01,
individual printing units 02, individual printing groups 03,
or individual cylinders 04, in particular individual forme
cylinders 04 of printing groups 03. In the same way, such a
unit can represent, for example, a unit 06, which further
processes the web after it has been imprinted, in particular
a folder 06, perforating arrangements, punches, collecting
arrangements, cutting arrangements, etc., for example.
Furthermore, such an independently driven unit can also be
one or several guide elements 07, for example traction
rollers, skip slitters, registration rollers, etc.

Fig. 1 shows three such units, which are driven
mechanically independently of each other by drive motors M.
For example, the two units shown at the left could be
printing towers 01, printing units 02, printing groups 03 or
cylinders 04. The middle one, or a further, not represented
unit could, however, also be a guide element 07. The right
unit represents, for example, a further processing unit 06,
in particular the folder 06.

Drive units 08, or regulating units 08, in a simplified
manner called drive units 08 with drive regulation in what
follows, are assigned to the respective drive motors M, which
are directly or indirectly connected with each other via at
least one signal line 09, and with a computing and data
processing unit 11, for example a computer 11. The computing
and data processing unit 11 can additionally have an
operating unit, or can be connected with an operating unit

10, for example a control console 10. Basically, the drive
units 08 (or controllers) can be connected via signal lines
12 with the signal line 09 in series (not represented),
directly in a ring or bus structure or, as represented, in a
tree structure.

The at least one signal line 09 conducts signals of a
master shaft position Phi, which is specified by a computing
unit 13, for example a higher-order drive control unit 13.
Together with the computing unit 13, the signal line 09
represents the so-called virtual master shaft 09, 13
(electronic shaft) for the units connected with it, by means
of which the units are aligned in respect to their position.
This master shaft position Phi is passed on to the drive units
08 as a set point (reference variable).

The computing and data processing unit 11 provides set
points in regard to the desired production speed to the
higher-order drive control unit 13, and in this way is
connected with the drive unit 08 via the higher-order drive
control unit 13, the signal line 09 (cross communication) and
the signal lines 12.

A specific offset Delta Phi_i, for example an angular
offset Delta Phi_i, can be preset in each controller 08, which
fixes a permanent, but adjustable displacement in relation to
the master shaft position Phi. This offset Delta Phi_i can be
entered, for example, directly at the regulator 08 and/or via
the computing and data processing unit 11 and/or can be
stored and called up in a memory of the computing and data
processing unit 11 for specific operating situations, in
particular specific web routings. If the signal line 09 is
correspondingly designed, for example as a broad-band bus or

broad-band network, the information regarding the
respectively specified and fixed offset Delta Phi, as well as
the "rotating" master shaft position Phi, can possibly be
provided over the common signal line 09. The signal line 09
can also additionally be connected with a control system 24,
which controls and/or regulates the actuators and drive units
of the printing units 02 or printing groups 03 or folders 06
which differ from the drive motors M, such as ink supply,
actuating movements of rollers and/or cylinders, dampening
unit, positions, etc. (the connection is represented by
dashed lines).

The respective offset Delta Phi_i is transmitted, for
example prior to the start of production run, from the
control console 10 or from the computing and data processing
unit 11 to the drive units 08 and is stored there. In an
advantageous embodiment, the offset Delta Phi_i can be changed
during the operation or the production run at the drive unit
08 itself, but in particular via the computing and data
processing unit 11.

In a variation, the offset values Delta Phi_i for the
various drive units 08 can also be stored in the higher-order
drive control unit 13. In this case each drive unit 08
receives, as a set point, the sum of the rotating master
shaft Phi and the specific stored offset value Delta Phi_i of
the respective drive unit 08 via the signal lines 09, 12 (or,
in series connection, only 09).

Thus all drive units 08, for example the drive units 08
of the two first units, laid out as printing towers 01, for
example, as well as the drive unit 08 of the unit embodied as
a folder 06, respectively follow the rotating master shaft

position Phi of the higher-order drive control unit 13 with a
respectively fixed offset value Delta Phi_i in respect to the
absolute position of the master shaft position Phi.

In contrast with Fig. 1, in Fig. 2 a signal line 14,
which is different from the signal line 09, has been provided
for the transmission of the respective offset Delta Phi_i
(and, if required, further relevant data). Furthermore, for
the connection between the signal line 09 and the signal line
12, or between the higher-order drive control unit 13 and the
drive unit 08, a communications node 17, for example a lower-
order drive control unit 17, is provided.

The computing unit 13 for specifying the master shaft
position Phi is connected, for example via the signal line
14, with the computing and data processing unit 11, from
which it in turn receives input in respect to the production
speed or the actual rpm set point, for example. Now the
respectively actual master shaft position Phi is specified by
the higher-order drive control unit 13 and fed into the
signal line 09. From there, the information regarding the
rotating master shaft position Phi is fed via the
communications node 17 to the signal line 12 and is there
directly provided to the drive units 08 which are relevant
for the actual production run. A communications node 17 can,
as represented in Fig. 2, be connected via the signal line
12, for example a network 12 of a ring or bus topology, with
several lower-order units each driven by a drive motor M such
as, for example, printing units 02, printing groups 03 or
cylinders 04. The lower-order units combined in this way via
a communications node 17 will be called in what follows a
group 18 of units or devices, which are mechanically driven

independently of each other. In this case the communications
node 17 passes on, for example, the master shaft position Phi
from the signal line 09 to the drive units 08 of all lower-
order units or devices (which take part within the scope of
the production run), for example printing units 02 or
printing groups 03 of this group 18.

In the example of Fig. 2, the center unit represents
such a group 18 of several sub-units, for example two
printing units 02, two printing groups 03 or two guide
elements 07, whose drive units 08 both receive the master
shaft position Phi via the communications node 17.

In a first embodiment, the production-specific offset
values Delta Phi$_i$ are forwarded from the computing and data
processing unit 11, or from the control console 10, to the
individual drive units 08 of the units, where they are stored
and further processed together with the master shaft position
Phi. In this case the forwarding takes place for example in
the manner of a tree structure from the signal line 14 via a
common signal line 16 per unit (or in a star shape via
several separate signal lines 16 per unit) to the drive units
08 (solid lines).

In a second embodiment (dashed lines) the forwarding of
the offset Delta Phi$_i$ takes place from the signal line 14 via
logical connections 16' directly or indirectly to the
respective communications node 17. The physical embodiment
of the logical connections 16' can be provided directly or
indirectly via further connections, such a bus couplers,
bridges, etc. or, for example, via a control system 24
represented in Figs. 1 or 3. In this case the signal line(s)
16 can be omitted. In a first variation of this embodiment,

the specific offset Delta Phi_i is forwarded from the
communications node 17 only via the signal line 12 to the
appropriate drive unit 08 and is stored there.

In a second advantageous embodiment, the communications
node 17 is designed as a lower-order drive control unit 17
with a memory and its own intelligence in such a way that the
offset values Delta Phi_i, which were specified for the
associated drive units 08 and the specific production run,
are stored there, and that the drive units 08 participating
in the production run are each provided with specific master
shaft positions Phi_i' (Phi_i' = Phi + Delta Phi_i) addressed to
them, for example as angular position set point Phi_i', by the
lower-order drive control unit 17. The interrelationship
shown is intended to merely explain the principle here and in
what follows. Of course, when following the specific master
shaft position Phi_i', it is necessary to take into
consideration the circumferences of the units to be driven,
etc., so that an actual interrelationship has further unit-
specific factors, for example.

Thus, the computing and data processing unit 11 is
connected on the one hand with the drive units 08 via the
higher-order drive control unit 13, the signal line 09 (cross
communication), as well as the signal lines 12, for example
buses 12. Information regarding the configuration (coupling
in printing units 02 and/or printing groups 03), or the
common production speed, can also be exchanged in this way.

The higher-order drive control unit 13 is connected with
the appropriate drive unit 08 for transmitting information
regarding the specific offset Delta Phi_i, as described above,
either via the signal line 14 and the signal lines 16, or via

the signal line 14, the logical connection 16', the
communication nodes 17 and the signal lines 12.

In the exemplary embodiment in accordance with Fig. 2,
the drive motors M, or the drive units 08 of the group 18,
are connected with each other and with the lower-order
control unit 17. The lower-order control units 17 of the
groups 18 or units are connected with each other and with the
higher-order drive control unit 13 via at least one signal
line 09. In addition, for transmitting the specific offset
values Delta Phi_i, the computing and data processing unit 11
is connected here with the drive units 08, or the
communications node 17, via at least one signal line 14.

In an advantageous embodiment, the signal line 09 is
designed here as a real time-capable connection 09 with a
fixed time frame for real time-relevant data and
deterministic time behavior. The connection 09 can
additionally have a channel in which, for example, data which
are not real time-relevant, such as the transmission of the
specific offset values Delta Phi_i in accordance with the
embodiment in Fig. 1, for example, and/or information
regarding the configuration, production speed, etc. in
accordance with the embodiment in Fig. 1, are transmitted.

The signal line 12 is also designed in an advantageous
embodiment as a real time-capable connection 12 with a fixed
time frame for real time-relevant data and deterministic time
behavior. The connection 12 can additionally have a channel
in which, for example, data which are not real time-relevant,
such as the transmission of the specific offset values Delta
Phi_i, and/or information regarding the configuration,
production speed, etc., are transmitted.

The signal lines 14 and 16 are preferably designed as a network 14, or a part of a network 14. In an advantageous embodiment, this network 14 can operate in accordance with a stochastic access method. However, data transmission should be possible at least by half-duplex operation.

Fig. 3 shows an example of the drive unit of a printing press with several, in this case three, printing towers 01, each of which has several printing groups 03, here double printing groups 03. Together with their drive units 08 and the motors M, the printing groups 03 of a printing tower 01 constitute a group 18, in particular a print position group 18, which is connected with the signal line 09 via the lower-order drive control unit 17 of this group 18. However, the drive control unit 13 can also manage sub-groups 02 of printing groups 03, for example printing units 02 or other divisions with assigned drive units 08. Further units, which have their own lower-order drive control units 17, for example one or several guide elements 07 and/or one or more folders 06 are also connected with this signal line 09. In this case the signal line 09 is advantageously designed in accordance with a ring topology, in particular in the form of a double ring, and has one or more of the properties mentioned in connection with Fig. 2, above.

The signal line 09 is connected with several, here two, higher-order drive control units 13, each of which can feed signals, which are different from each other, of a respective master shaft position Phia, Phib from a master shaft a, b into the signal line 09. This is advantageous, for example, if it is intended to assign the printing press, or its printing towers 01 and/or printing units 02 and/or printing groups 03

and the associated folders 06, as well as guide element 07, to several sections 21, 22, which can be operated separately or together. However, production runs and web tracks can pass over the separation between the sections, which in Fig. 3 is indicated by a dashed line, and can be conducted from printing units 03 of the one section 21, 22 into printing units 03, and/or the folders 06 of the other one. For example, the individual printing towers 01 can be assigned to different folders 06. Inside a printing tower 01 sub-groups, for example printing units 03, can also be assigned to different webs with different web tracks, which can be conducted to a common folder 06, or even to different ones. Therefore the sections 21, 22 should logically not be considered as rigid units.

The higher-order drive control units 13 receive their specifications regarding the starting point and the production speed of the respective sections 21, 22, and/or the web track, from a respectively assigned computing and data processing unit 11, which in turn is connected with at least one control console 10. In an advantageous embodiment, the two computing and data processing units 11 are connected with each other and with a further signal line 23, which connects several, here two, control consoles 10 with each other.

The offset values Delta Phi_i relevant to the individual drive units 08 for the respective production run are fed from the computing and data processing unit 11 via the signal line 14 to the lower-order drive control units 17 assigned to the respective drive unit 08 and are stored there in an advantageous embodiment, as described in connection with Fig.

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2, and are processed, together with the master shaft position
Phia, Phib, to form the master shaft positions Delta Phi_i'.
If sub-groups, for example printing units 03 of a group 18,
for example of a printing tower 01, are assigned to two
different webs, the lower-order drive control unit 17
processes, together with the offset value Delta Phi_i which
was specified for the respective web, the respective master
shaft position Phia, Phib of the master shaft a, b assigned
to the respective drive unit 08, depending on the association
of the respective print position with the one or the other
web.

However, in this example the transmission to the lower-
order drive control units 17 does not take place directly,
but via a control system 24, which is assigned to the
respective group 18, or to the unit having its own lower-
order drive control unit 17 (for example a folder 06). The
control system is connected with the signal line 14 (or the
computing and data processing unit 11) either via its own
signal lines 25, for example, or the line sections 25 are
part of the signal line 14 embodied as a network 14. For
example, the control system 24 controls and/or regulates the
actuating members and drive units, which are different from
the drive motors M, of the printing units 02, or print
position groups 18, or printing groups 03, or folders 06, for
example the ink distribution, actuating movements of rollers
and/or cylinders, dampening unit, positions, etc. The
control system 24 has one or several (particularly memory-
programmable) control units 26. This control unit 26 is
connected with the lower-order drive control unit 17 via a
signal line 27. In the case of several control units 26,

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these are then also connected with each other via the signal
line 27.

In an advantageous embodiment, the control system 24,
or its control unit(s) 26 is/are releasably connected with
the signal line 14 by coupling devices, not represented, for
example bus couplers. Therefore the group 18 can in
principle be operated as a unit closed on itself, wherein the
control of the drive units 08 takes place via the train of
the lower-order drive control unit 17 with the signal line
12, and the control of the further functions of the group 18
via the train of the control system 24. Set points. as well
as actual values, and deviations can be input or output via
the couplers. In this case the lower-order drive control
unit 17 performs the specification of a master shaft position
Phi. For this reason, and for reasons of redundancy, it is
advantageous if all lower-order drive control units 17 are
designed with the option of generating and specifying a
master shaft position Phi.

In the embodiment in accordance with Fig. 3, the offset
values Delta Phi$_i$ are conducted from the signal line 13 via
the respective control system 24 to the relevant lower-order
drive control unit 17. As described in the exemplary
embodiment in Fig. 2, the offset values Delta Phi$_i$ can be
alternatively provided from there to the drive units 08 and
stored and processed there.

With the exemplary embodiments in Figs. 2 and 3, the
higher-order drive control unit 13 can be omitted if, for
example, one or several groups 18, or one of the units with
their own lower-order drive control unit 17 (for example the
folder 06) have a lower-order drive control unit 17. The

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virtual master shaft, or the master shaft position Phi, can then be specified by one of the drive control units 17.

As described in Figs. 2 and 3, it is very advantageous to provide separate signal lines 09, or 16, 16', 14, 25, 27 for the rotation of a master shaft not yet adapted to the individual drive unit 08 and the information regarding the angular position (offset values Delta Phi_i, deviations from the registration). In this way it is possible, for one, to the basic alignment of the individual drives 08 by transmitting and/or changing the offset values Delta Phi_i, as well as a correction of the angular position required during the production run in view of the regulation of the linear registration, via the separate signal lines 16, 16', 14, 25, 27 to the lower-order drive control units 17 (or the drive units 08 themselves). In case of a registration regulation, for example, an appropriate actuation value is conducted via the signal line 27 to the control unit 17 and is superimposed on the set point formed from the master shaft position and offset Delta Phi_i in the course of determining the specific angular position set point for the individual drive unit 08. By means of proceeding in this way, an increased flow of data over the signal line 09 conducting the master shaft is avoided. It is also not necessary to conduct many different data packets, which are already matched to the respective drive unit 08, over this signal line 09. In respect to the individual drive unit 08, this would result in a clearly reduced possible signal rate. The lower-order drive control units 17 merely manage a tightly restricted number of drive units 08, so that the data in the signal lines 12 can be

handled accordingly. But this is not comparable to the number of all drive units 08 assigned to an entire section.

For all described embodiments, at least one master shaft position Phi, Phia, Phib is specified by at least one drive control unit 13, 17, which is used by the drive units 08 of the different units, driven independently of each other, for the alignment of their position. A specific offset value Delta Phi_i can be assigned to each one of these drive units 08, which expresses the respective desired position in relation to the master shaft position Phi, Phia, Phib of the assigned master shaft a, b. Thus, for a defined production run, for example, specific offset values Delta Phi_i in respect to the master shaft a, b which is relevant to this production run, are assigned to all drive units 08, which are mechanically independent of each other, of the printing towers 01 (or printing units 02 or printing groups 03), as well as to the assigned drive unit 08 of the folder 06 and, if required, guide elements 07.

These offset values Delta Phi_i are substantially based on purely geometric conditions. For one, they are a function of the selected web track, i.e. of the web path between the individual units. Moreover, they can be a function of an accidental or selected neutral position of the individual drive unit 08. The latter does not apply to the individual drive unit 08, if its defined neutral position coincides with the neutral position of the master shaft a, b.

Fig. 4 schematically represents the components of a drive unit 08 with a drive motor M. The drive unit 08 has at least one controller 28, as well as a power element 29 for

feeding in energy, for example. The drive unit 08 is connected with a sensor 21, in particular an angle pulse generator 31, which reports the actual angle of rotation position of the drive motor M, or of the unit to be driven, to the controller 28. The angle pulse generator 31 is connected with a shaft, not represented, of the drive motor M and follows its rotary movement (1 : 1, or in another defined way). The angle pulse generator 31 can also be arranged on the unit to be driven by the drive motor M.

For example, a basic setting of the drive units 08, or the determination and fixation of the offset values Delta Phi_i, now takes place as follows:

Prior to the first start-up, a so-called basic registration position (0-position) must be approached as the reference position in the printing units 02, or the printing groups 03, and in the folder 06. The same applies following the exchange of one or several drive units 08 of the units or devices involved. This reference position is the position the folder 06 has in respect to registration in relation to the printing unit 02 (or the printing group 03), or the forme cylinder 04 (and the counter-pressure cylinder within a printing group 03). In an advantageous embodiment, the reference position is fixed by a mechanical visual marker at least at the forme cylinder 04 (and the counter-pressure cylinders) of the printing groups 03, and at least at one of the cylinders, or rollers, of the folder 06, in particular at the cutting cylinder.

For this purpose, the drive unit 08, or the drive motor M, is set mechanically, or by an electrical reverse movement, to the mechanical visual marker. The value from the angle

pulse generator 31 is stored as the zero position, for
example manually or by means of a service PC, at the drive
08, or its controller 28. Memorizing can alternatively take
place by means of the command "take up reference position" at
the control console 10, wherein the value of the connected
angle pulse generator is also stored as the zero position in
the drive unit 08, or its controller 28.

Since as a rule the zero position taken over from the
mechanical visual marker merely represents a rough value, now
the actual offset value Delta Phi_i, or the angle offset Delta
Phi_i, in relation to the master shaft position Phi, Phia,
Phib, as a function of the web track and additional factors,
and corresponding to the print image, or the cut following
the first printing, is determined mechanically or by
appropriate measuring devices. As a rule, the determination
of the offset values Delta Phi_i is not made in the form of an
angular measure, but as a length, for example in mm.
However, this changes nothing in the basic principle of
determination and storage, but only in connection with the
further processing since, knowing the circumference of the
respective units working together with the web, the linear
measure can be converted into a angular measure and vice
versa.

The value determined (for example in mm) of the offset
Delta Phi_i is performed by means of an input mask, for
example, for the so-called print registration input, or the
print offset. These offset values Delta Phi_i (for example in
mm) are passed on via the signal line 14 (and, if provided,
the signal line 23) as explained above to the drive units 08
or the lower-order drive control units 17. If input is

provided in mm, the values are converted to angle
measurements. For example, the offset values Delta Phi_i, if
they are transmitted via the control systems 24 (in
accordance with Fig. 3), are converted there to the
corresponding offset values Delta Phi_i in the form of angle
measurements. These values Delta Phi_i converted to angles
are passed on in turn by the control system 24, or the
control units 26, to the associated lower-order drive control
unit 17 and are stored there in the form of offset values
Delta Phi_i (in angle measurements).

The offset Delta Phi_i for the drive unit 08 of the
folder 06 regarding the so-called folding print offset is
input in the same way at the control console 10 and/or the
computing and data processing unit 11, the storage of this
offset value Delta Phi_i takes place in the drive unit 08 of
the folder 06.

In principle, offset values Delta Phi_i can assume any
arbitrary values resulting from the offset in respect to the
master shaft a, b. The offset value Delta Phi_i can also be
zero for individual drive units 08 of the printing groups 03
or of the folder 06, i.e. there is no offset.

For automating, the manually determined offset values
Delta Phi_i, which are a function of the web track, can be
stored via the control console 10 and, when this production
run is repeated, can be recalled and again passed on to the
drive units 08 over the above mentioned track.

If now the printing press, or the respective unit, is
operated, drive unit 08 follows with its neutral position
plus added offset Delta Phi_i the guide position Phi, Phia,
Phib and therefore is always in the correct position. Fig. 5

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schematically represents this state with the master shaft a, b, which is common for the printing group 03 and the folder 06, and the master shaft position Phi, Phia, Phib. The printing group 03, or the drive unit 08 driving it, receives the position Phi + Delta Phi_{DWj}, i.e. the sum of the master shaft position Phi, Phi, Phib and the offset Delta Phi_{DWj} which is specific (for this web track) for the j-th printing group 03, and the folder 06, or its drive unit 08, the position Phi + Delta Phi_{FAk}, the sum of the master shaft position Phi, Phi, Phib and the offset Delta Phi_{FAk} which is specific (for this web track) for the k-th folder 06. These connections represent, as already mentioned above, the simplified principle without any further unit-specific factors.

In an advantageous embodiment, a correction of the respective offset Delta Phi_i is also possible from the control console 10, or the computing and data processing unit 11, during a production run, or with the press running.

Start-up, or the operation of the printing press takes place as follows, for example:

For preparing for a defined production run, all units or devices required for this production run are configured manually from the control console 10, or by means of data which are prepared (memorized) or read-in via a higher-order production system, and their drive units 08 are thus coupled to the appropriate master shaft a, b.

Drawing in the web or webs is subsequently possible, for example. To this end the release of the movement of the master shaft a, b, takes place, for example, upon a command "draw in" (if required, following a pre-warning by the

system, that the network contactors of the drive units 08
have been turned on, and possibly another command).

In the same or similar way, start-up can take place
with the web already drawn in or the webs drawn in.

During start-up or a new start of the production run,
the master shaft position Phi, Phia, Phib is started from a
defined stop position (angle position zero, or another
fixedly preset value) or, in an advantageous embodiment, from
the last position (last count or angle prior to taking up the
motion again) which are stored, for example, in a permanent
memory. All coupled drive units 08 required to maintain the
registration must thereafter be aligned, corresponding to
their preset conditions (offset values Delta Phi_i), in
accordance with this preset condition.

Periodically at the end of a time interval of, for
example 2 to 5 ms, a fresh guide position Phi, Phia, Phib is
put out by the higher-order drive control unit 13 to all
drive units 08 involved in the production run, or the lower-
order drive control units 17, via the signal lines 09.
During start-up, the master shaft a, b rotates at a reduced
speed, or number of revolutions, for example corresponding to
1 m/min. At the start, the various drive units 08 can
possibly be located arbitrarily "rotated" in respect to the
master shaft a, b.

Now the drive units 08 all follow this master shaft
position Phi, Phia, Phib, or the specific master shaft
positions Phi_i', i. e. the press is running. If drive units
08, for which there is the requirement of maintaining
registration (for example the printing groups 03 and the
folder 06), still show deviations from the respectively

specific master shaft positions Phi_i', they rotate faster or slower until they have reached the specific master shaft position Phy_i', i.e. are synchronized.

All guide elements 07 at the web, for example traction elements, are synchronized, at least in respect to their circumferential speed, with the master shaft position Phi, Phia, Phib, or its angular speed.

In an advantageous embodiment, the production speed is only increased, for example to a number of revolutions corresponding to a web speed of 5 m/min, after synchronous running (synchronicity of position or speed) of all drive units 08 is acknowledged..

At a constant speed, the master shaft position Phi, Phia, Phib is passed on every 2 to 5 ms, for example by the higher order drive control unit 13, to the drive units 08, or the lower-order drive control units 17. A command "faster" results in an increased angular difference from the old to the new. When actuating "stop" and/or "block", all drive units 08 guided by the master shaft a, b return, for example via a ramp, to zero revolutions, and the network contactors of the drive units 08 are shut off, for example, a folder brake becomes active in an advantageous embodiment.

By means of the described way of operating, the master shaft a, b always specifies the position at any time (except for the above mentioned clock frequency of the position transmission), and all coupled drive units 08 follow this position.

The offset values Delta Phi_i determined (and corrected, if required) for this production run, or web track, are stored and specified, for example, in the computing and data

processing unit 11 or the control console 10. If at a later
time the same production run or web track is to be employed,
these offset values Delta Phi$_i$ can be called up and sent to
the drive units 08, or to the drive control units 13, or in
particular to the drive control unit 17, via the above
described routes. This can take place automatically, for
example, with the call-up of a configuration, which was
already stored or transmitted via a higher-order print shop
administration system to the control console 10.

        In accordance with a variation, the master shaft
position Phi, Phia, Phib from the instantaneous angle
position of a drive unit 08 of one of the units or devices is
taken over on start-up or renewed production run. In this
case an offset value Delta Phi$_i$ of zero exists between this
drive unit 08 and the master shaft position Phi, Phia, Phib,
at least at the start. In the further course of events, the
remaining coupled drive units 08 with the requirement of
maintaining registration must be aligned in accordance with
their preset conditions (offset values Delta Phi$_i$) with the
master shaft position Phi, Phia, Phib, as described above.
In this case the master shaft a, b again specifies the
position at each point in time, and all coupled drive units
08 (for example also the drive unit 08 used for aligning the
master shaft a, b) follow this position. The drive unit 08
used for the alignment can then be charged for correction
with an offset value Delta Phi$_i$ not equal to zero in the
further course of start-up and/or the production run since,
following the alignment of the master shaft a, b while
standing still, all coupled drive units 08 align themselves
only with the master shaft a, b.

Basically, the drive unit 08 used for the alignment can
be any drive unit 08 which has the requirement of maintaining
registration, for example a drive unit 08 of a printing group
03. However, in an advantageous embodiment the drive unit 08
of the folder 06, or the position of a cylinder of the
folder, for example the cutting cylinder, is employed for the
alignment. Following the alignment, i.e. during operation,
for example, the drive unit of the folder 06 receives the
input again from the common master shaft a, b.

In a third variation for the alignment and the
operation of the master shaft a, b, the master shaft a, b is
not only synchronized for alignment with the angular position
of the unit or device used for alignment, for example the
folder 06, or its drive unit 08, but during the operation
also receives its position permanently or cyclically from the
position of this unit, or this device, for example from the
folder. In this variation the position of all remaining
drive units 08 is specified by means of the position of this
unit or this device, the offset value Delta Phi$_i$ between this
unit and the master shaft a, b is always zero.

In regard to the linear registration (circumferential
and/or cutting registration), it is basically possible to
distinguish between at least three types or errors:

The imprints (images) of different webs are, for
example, not in registration with each other, but the cut
agrees at least with one imprint, or web. In this case, for
example, the printer either compensates for the registration
error by manually changing the track preset at the control
console, for example a change of a linear registration roller
between the last print position of the web in question and

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the folder 06. However, a change of the offset values Delta Phi$_i$ for the drive units 08 of the printing groups 03 of this web can also take place. Both variations can also take place automatically from a registration regulation unit.

If the imprints agree with each other, but the cut does not fit the imprint, the correction is possible from the control console by means of the so-called fold print offset, i.e. a change of the offset Delta Phi$_i$ for the drive unit 08 of the folder 06. The offset of the is changed to an appropriate value.

If in a printing operation the position of the colored inks in respect to each other does not agree in the circumferential direction, the offset value Delta Phi$_i$ of one or several of the printing groups 03 involved can be changed at the control console 10 manually or aided by an appropriate regulating system with a sensor, and their relative positions in respect to each other can be changed.

List of Reference Symbols

01	Printing tower
02	Printing unit, sub-group
03	Printing group, double printing group
04	Cylinder, forme cylinder
05	-
06	Further processing unit, folder
07	Guide element
08	Drive unit
09	Signal line, connection
10	Operating unit, control console
11	Computing and data processing unit, computer
12	Signal line, network, buses
13	Computing unit, higher-order drive control unit
14	Signal line, network
15	-
16	Signal line, connection
17	Communications node, lower-order drive control unit
18	Group, print position group
19	-
20	-
21	Section
22	Section
23	Signal line
24	Control system
25	Signal line
26	Control unit

27	Signal line
28	Controller
29	Power element
30	-
31	Sensor, angle pulse generator

16'	Logical connection

Phi	Master shaft position
Phia	Master shaft position
Phib	Master shaft position
Delta Phi_i	Offset, offset value, angular offset
Delta Phi_{DWj}	Offset, j-th printing group
Delta Phi_{FAj}	Offset, k-th folder
Phi_i	Specific master shaft position
Phi_i'	Master shaft position, angular position set point

M	Drive motor